

CLAIMS:

1. A hygroscopic scintillator element suitable for selective response to tritiated water vapour and
5 other hydrophilic tritiated species in a gas, which scintillator comprises a solid scintillator material having a layer of hygroscopic material thereon.

10 2. A scintillator element according to claim 1 wherein said solid scintillator material comprises any of, a plastic, an inorganic "phosphor" (such as doped zinc sulphide) an oxide based material, a glass or a combination of these materials.

15 3. A scintillator element according to claim 1 or 2 wherein said hygroscopic material comprises a layer of a hygroscopic or deliquescent substance as a solution or as an aqueous gel.

20 4. A scintillator element according to any preceding claim wherein said hygroscopic material comprises an aqueous or gel solution of a deliquescent salt, base or organic salt or an inorganic or organic substance which can absorb water, or a combination of
25 any of said substances.

30 5. A scintillator element according to ^{claim 1} ~~any preceding claim~~ wherein said hygroscopic material is any of zinc chloride, potassium acetate, phosphoric acid or lithium chloride.

35 6. A scintillator element according to ^{claim 1} ~~any preceding claim~~ which further comprises a hydrated solid such as zeolite.

7. A scintillator element according to ^{claim 1} ~~any preceding claim~~ which is in the form of a sheet,

fibre, rod, spiral roll, powder, a powder compact, varnish, paint or a combination thereof.

5 8. A method for making a hygroscopic scintillator element, suitable for selective response to tritiated water vapour or other hydrophilic tritiated species in a gas, which method comprises coating a solid scintillator material with a layer of a hygroscopic material.

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9. A method according to claim 8 which further comprises pre-treating the solid scintillator material with a detergent or subjecting it to a hydrophilic surface treatment.

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10. A method according to claim 9 wherein said pre-treating step comprises sulfonation.

20 11. A method for monitoring the activity of tritiated water vapour or other hydrophilic tritiated species in a gas, which method comprises:

- (a) providing a hygroscopic scintillator element according to ^{claim 1} ~~any of claims 1 to 7~~ for contact with a gas to be tested;
- 25 (b) measuring the light emitted from said hygroscopic scintillator using measuring means, the amount of said light emitted from said scintillator element providing a measure of the activity of the tritiated water vapour or said
- 30 hydrophilic tritiated species in the gas.

12. A method according to claim 11 wherein said hygroscopic scintillator is provided in an aperture in the wall of a substantially light-tight plant

35 containing said gas, a suitable window or aperture being provided to allow said measuring means to measure only light emitted from the said hygroscopic

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scintillator element.

13. A method according to claim 11 wherein said
hygroscopic scintillator element is provided in a
5 substantially light-tight container, which
incorporates an inlet adapted to allow the access of
said gas to said element and which prevents light
entry to or escape from said container.

10 14. A method according to claim 11 which
NAB container additionally includes an outlet to allow
passage of said gas therethrough.

15 15. A method according to ^{claim 9} ~~any one of claims 9 to~~
NAB 14 wherein the light emitted by said hygroscopic
scintillator is measured remotely by said measuring
means spatially separated from said hygroscopic
scintillator, but optically connected thereto.

20 16. A method according to ^{claim 11} ~~any of claims 11 to 15~~
NAB wherein the time averaged output of the measuring
means is measured as a continuous current, and used to
indicate the tritium radiotoxicity of said gas, and/or
its tritiated water activity on a meter, a digital
25 display as an audible signal, and/or as an output to a
computer, data logger, recorder, control system.

30 17. A method according to ^{claim 9} ~~any one of claims 9 to~~
NAB 16 wherein said measuring means comprises one or more
photomultiplier tubes, multichannel plates or
photodiodes.

35 18. A method according to claim 17 wherein the
rate of signal pulses from said measuring means is
measured and used to indicate the tritium
radiotoxicity of said gas, and/or its tritiated water
activity, on a meter, a digital display as an audible

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signal, and/or as an output to a computer, data logger, recorder, or control system or the like.

19. A method according to claim 17 ~~or 18~~ wherein more than one photomultiplier tube, multichannel plate or photodiode is provided.

Claim 11
20. A method according to ~~any of claims 11 to 19~~ which further comprises using a non-discriminating tritium monitor in order to measure, by difference, the activities in said gas of both tritiated water and elemental tritium.

21. A method according to claim 20, wherein the non-discriminating monitor is substantially identical to the scintillator element ~~according to any of claims 1 to 7~~, with the exception that the hygroscopic layer is omitted in the non-discriminating monitor.

Claim 9
22. A method according to ~~any of claims 9 to 21~~ wherein said gas to be measured is air.

23. Apparatus for monitoring the activity of tritiated water vapour and other hydrophilic tritiated species in a gas, which apparatus comprises:

(a) ~~a hygroscopic scintillator element according to any of claims 1 to 7~~; and

(b) means for measuring light emitted from said hygroscopic scintillator element, the amount of light emitted from said scintillator element providing a measure of the tritium containing species in said gas.

24. Apparatus according to claim 23 wherein said scintillator element is provided in a substantially light tight container including inlet means adapted to allow the gas to contact the scintillator element

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without permitting entry or exit of light to or from said container.

25. Apparatus according to claim 23 or 24 which further comprises means for contacting said gas with said hygroscopic scintillator element.

26. Apparatus according to ^{Claim 25} ~~any of claims 23 to 25~~ which further comprises an outlet in said container to allow passage of said gas or vapour therethrough.

27. Apparatus according to claim 25 ~~or 26~~ which comprises a pump to facilitate the passage of gas through said container.

28. Apparatus according to ^{Claim 23} ~~any of claims 23 to 27~~ wherein the light emitted by said hygroscopic scintillator element is measured remotely by said light measuring means spatially separated from said hygroscopic scintillator, but optically connected thereto by means of a light guide.

29. Apparatus according to ^{Claim 23} ~~any of claims 23 to 28~~ wherein said scintillator element is provided in the form of a sheet, fibre, rod, spiral roll, powder, a powder compact, varnish, paint, or a combination of said forms.

30. Apparatus according to ^{Claim 23} ~~any of claims 23 to 29~~ wherein said measuring means comprises one or more photomultiplier tubes, multichannel plates or photodiodes.

31. Apparatus according to claim 30 wherein the rate of signal pulses from said measuring means is measured and used to indicate the tritium radiotoxicity of said gas, and/or its tritiated water

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activity, on a meter, a digital display, as an audible signal and/or as an electrical output to a computer, data logger, recorder or control electronics.

5 32. Apparatus according to claim 30 wherein a plurality of a photomultiplier tube, multichannel plate or photodiode is provided.

10 33. Apparatus according to ^{Claim 31} ~~claims 31 or 32~~ wherein the time averaged output of said measuring means is measured as a continuous current, and used to indicate the tritium radiotoxicity of said gas on a meter, a digital display as an audio signal, and/or as an output to a computer, data logger, recorder, control system or the like.

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20 34. Apparatus according to ^{Claim 23} ~~any of claims 23 to 33~~ which further comprises a non-discriminating tritium monitor so as to measure, by difference, the concentrations in said gas or vapour of both tritiated water or other possible hydrophilic species and elemental tritium or other hydrophobic radioactive species present.

25 35. Apparatus, according to claim 34, wherein said non-discriminating monitor is substantially identical to a scintillator element ~~according to any of claims 1 to 7~~, with the exception that the hygroscopic layer is omitted in the non-discriminating monitor.

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35 36. Apparatus according to ^{Claim 23} ~~any of claims 23 to 35~~ which further comprises a second sealed radiation monitor to compensate for background radiation fields, by subtraction.

37. Apparatus according to claim 35 wherein said

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sealed radiation monitor is substantially identical to the scintillator ~~according to any of claims 1 to 3~~ and sealed in a container free of radioactive gas.

5 38. Apparatus according to claim 23 wherein the gas to be monitored comprises air.

39. Apparatus according to claim 23 which is incorporated in a breathing mask.

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